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DETECTION BY LOW TEMPERATURE PHOTOLUMINESCENCE OF OXYGEN RECOILS IN "THROUGH-OXIDE" ARSENIC
IMPLANTED SILICON

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The technique of low-temperature photoluminescence is used to study the damage induced by arsenic implantations through SiO_2 layers. The presence of an oxygen dependent damage center in only the "through-oxide" implanted samples and in none of the samples implanted into bare surfaces is interpreted as indicating the presence of oxygen recoils from the oxide. It is also seen that the in-diffusion of oxygen during thermal growth of the SiO_2 is insufficient to produce detectable oxygen-dependent luminescence after irradiation.

Superionic conductors¹ which show phase changes are an intriguing group of materials to study because of the possible different origins of their transitions. For example, the following questions can be asked. Is the phase transition driven by a soft mode and does the new phase, just by chance, have the proper arrangement for fast ion conduction? Is the phase transition driven by the need for the crystal to conduct which causes a transition to a phase with useful paths for the ions to move? Is the phase change driven by a combination of these and other mechanisms, and thus some modes will soften as T approaches T_c ?

One way to begin to answer some of these questions is to study the lattice vibrational spectra above and below T_c . We report such a study in RbAg_4I_5 using the Raman technique and compare these results to those found in AgI , where we had previously observed very large, abrupt, reversible changes in the Raman spectra at T_c .

RbAg_4I_5 has a first-order transition^{2,3} at $T = 121^\circ\text{K}$, where the d.c. conductivity increases by a factor 100, and a second-order phase transition at $T = 208^\circ\text{K}$, where the conductivity is continuous but $d\sigma/dT$ has a discontinuity. At room temperature RbAg_4I_5 has a complicated cubic structure⁴ with space group O^7-P4_13 (or its enantiomorphic space group O^6-P4_33). There are four formula units per cell but the material is highly disordered since the 16 Ag^+ ions are randomly distributed over 56 sites. This space group does not have a center of inversion as a symmetry operation, yet it is not piezoelectric so infrared active phonon modes should not be Raman active (the exclusion rule) unless the disorder breaks this selection rule. On the other hand if the low temperature structures have space groups that are subgroups of O^7-P4_13 then they will be piezoelectric and most likely have infrared modes that are also Raman active. In fact, using the electric field echo technique⁵, we have determined that the crystal is piezoelectric below 121°K . We will return to this point in discussing the results.

The material used in this study was prepared by reacting the proper concentrations of purified AgI and RbI in a sealed silica tube. The reacted mass was then slowly lowered through a heated zone where the maximum temperature was 215°C . The resulting material contained several large crystals, with a lattice constant of

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